

WHAT IS CLAIMED IS:

- 1        1.     A method for generating a user interface, wherein an application program processes data and generates application output and wherein a user interface module processes the application output to generate output data to render on an output device, comprising:
  - 4            generating output data, with the user interface module, to render on the output device in response to processing statements in the user interface module;
  - 6            reaching a processing point, with the user interface module, where the user interface module does not include statements to generate output data;
  - 8            receiving, with the user interface module, an interaction object from the application program specifying data after reaching the processing point; and
  - 10          generating output data to render on the output device from the interaction object.
- 1        2.     The method of claim 1, wherein the interaction object further includes attribute information indicating characteristics of the data to output, wherein the output data is rendered in a format corresponding to the characteristics indicated in the attribute information.
- 1        3.     The method of claim 1, wherein the user interface module comprises a Controller and View and the application program comprises a Model conforming to the Model View Controller architecture.
- 1        4.     The method of claim 3, wherein the Controller includes the statements that are processed to generate output data, further comprising:
  - 3            requesting, with the Controller, the interaction object from the Model upon reaching the processing point; and
  - 5            transferring, with the Controller, the received interaction object to the View, wherein the View generates the output data to render from the interaction object.

1       5.     The method of claim 4, wherein the output data generated by the Model  
2 includes questions, further comprising:

3           receiving, with the View, user input in response to the presented questions;  
4           adding, with the View, the received user input to the interaction object including the  
5 output data generated by the View; and  
6           returning the interaction object including the received user input to the Model to  
7 process.

1       6.     The method of claim 5, wherein returning the interaction object including the  
2 received user input to the Model further comprises:

3           transmitting, with the View, the interaction object including the answers to the  
4 Controller; and  
5           transferring, with the Controller, the Interaction Object including the received user input  
6 to the Model.

1       7.     The method of claim 1, wherein multiple user interface modules are capable of  
2 generating output data from the interaction object, wherein each user interface module  
3 generates the output data to render in a different format.

1       8.     The method of claim 7, wherein each user interface module generates the  
2 output data to render on a different type of output device.

1       9.     The method of claim 1, further comprising:  
2           continuing to generate, with the user interface module, output data in response to  
3 processing statements in the user interface module after the output data generated from the  
4 interaction object is rendered on the output device.

1        10.     A method for generating a user interface, wherein an application program  
2 processes data and generates application output and wherein a user interface module processes  
3 the application output to generate output data to render on an output device by:  
4            generating output data to render on the output device in response to processing  
5 statements in the user interface module;  
6            receiving an interaction object from the application program specifying data to generate  
7 as output data;  
8            generating output data to render on the output device from the interaction object from  
9 the data specified in the interaction object;  
10          receiving user input in response to the output data rendered on the output device from  
11 the interaction object;  
12          adding the received user input into the interaction object; and  
13          returning the interaction object including the received user input to the application  
14 program.

1        11.     The method of claim 10, wherein the interaction object further specifies  
2 attribute information, wherein the output data is rendered on the output device in a format that  
3 corresponds to the specified attribute information.

1        12.     The method of claim 10, wherein the interaction object comprises a plurality of  
2 interactions, wherein each interaction includes data to cause the user interface module to render  
3 a message or question on the output device.

1        13.     The method of claim 12, wherein each interaction is capable of providing  
2 information to cause the user interface module to generate a question that is a member of a set  
3 of questions comprising:

4           a true false question;  
5           an essay question; and  
6           a multiple choice question.

1           14.     The method of claim 12, wherein one or more interactions may include data to  
2 render a multiple choice question by providing:  
3           a question string comprising a question presented to the user;  
4           a choice array comprising a plurality of user selectable choices to present as responses  
5 to the presented question, wherein the choices in the choice array are presented on the output  
6 device with a selection mechanism to enable selection of at least one of the choices; and  
7           a selection array indicating which user selectable choices were selected through the  
8 selection mechanism, wherein the selection array comprises the received user input in response  
9 to the presented question.

1           15.     The method of claim 14, wherein the interaction including data to render a  
2 multiple choice question further includes:  
3           an allowable selection variable indicating a maximum number of user selectable choices  
4 that may be indicated as selected in the selection array.

1           16.     The method of claim 10, wherein the user interface module comprises a  
2 Controller and View components and the application program comprises a Model conforming  
3 to the Model View Controller architecture.

1           17.     The method of claim 10, wherein multiple user interface modules are capable of  
2 generating output data from the interaction object, wherein each user interface module  
3 generates the output data to render in a different format.

1       18.     The method of claim 17, wherein each user interface module generates the  
2 output data from the interaction object to render on a different type of output device.

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1       19.     A system for generating a user interface on an output device, comprising:  
2           a computer readable medium;  
3           an application program means for processing data and generating application output;  
4           an interaction object included in the computer readable medium specifying data to  
5 generate, wherein the application program means generates the interaction object; and  
6           a user interface module means for generating output data to render on the output device  
7 by performing:

- 8               (i) processing statements in the user interface module to generate output data to  
9               render on the output device;  
10              (ii) reaching a processing point where the user interface module does not  
11               include statements to generate output data;  
12              (iii) receiving an interaction object from the application program specifying data  
13               after reaching the processing point; and  
14              (iv) generating output data to render on the output device from the interaction  
15               object.

1       20.     The system of claim 19, wherein the interaction object further includes attribute  
2 information indicating characteristics of the data to output, wherein the user interface module  
3 means renders the output data in a format corresponding to the characteristics indicated in the  
4 attribute information.

1        21.     The system of claim 19, wherein the user interface module means includes a  
2     Controller means and View means and the application program comprises a Model means  
3     conforming to the Model View Controller architecture.

1        22.     The system of claim 21, wherein the Controller means includes the statements  
2     that are processed to generate output data, wherein the Controller means further performs:  
3              requesting the interaction object from the Model upon reaching the processing point;  
4     and  
5              transferring the received interaction object to the View, wherein the View generates the  
6     output data to render from the interaction object.

1        23.     The system of claim 22, wherein the output data generated by the Model means  
2     includes questions, wherein the View means further performs:  
3              receiving user input in response to the presented questions;  
4              adding the received user input to the interaction object including the output data  
5     generated by the View; and  
6              returning the interaction object including the received user input to the Model to  
7     process.

1        24.     The system of claim 23, wherein returning the interaction object including the  
2     received user input to the Model is performed by:  
3              transmitting, with the View means, the interaction object including the answers to the  
4     Controller; and  
5              transferring, with the Controller means, the Interaction Object including the received  
6     user input to the Model.

1        25.     The system of claim 19, further comprising: multiple user interface module  
2 means capable of generating output data from the interaction object, wherein each user  
3 interface module means generates the output data to render in a different format.

1        26.     The system of claim 25, wherein each user interface module generates the  
2 output data to render on a different type of output device.

1        27.     The system of claim 19, wherein the user interface module means further  
2 performs:  
3              continuing to generate, with the user interface module, output data in response to  
4 processing statements in the user interface module after the output data generated from the  
5 interaction object is rendered on the output device.

1        28.     A system for generating a user interface on an output device, comprising:  
2              a computer readable medium;  
3              an application program means for processing data and generating application output;  
4              an interaction object included in the computer readable medium specifying data to  
5 generate, wherein the application program means generates the interaction object; and  
6              a user interface module means for generating output data to render on the output device  
7 by performing:  
8                  (i) receiving the interaction object specifying data to generate as output data;  
9                  (i) generating output data to render on the output device from the interaction  
10 object from the data specified in the interaction object;  
11                  (ii) receiving user input in response to the output data rendered on the output  
12 device from the interaction object;  
13                  (iii) adding the received user input into the interaction object; and

14 (iv) returning the interaction object including the received user input to the  
15 application program.

1           29. The system of claim 28, wherein the interaction object further specifies attribute  
2 information, wherein the output data is rendered on the output device in a format that  
3 corresponds to the specified attribute information.

1           30. The system of claim 28, wherein the interaction object comprises a plurality of  
2 interactions, wherein each interaction includes data to cause the user interface module means to  
3 render a message or question on the output device.

- 1        31. The system of claim 30, wherein each interaction is capable of providing
- 2 information to cause the user interface module means to generate a question that is a member of
- 3 a set of questions comprising:
  - 4            a true false question;
  - 5            an essay question; and
  - 6            a multiple choice question.

1        32. The system of claim 30, wherein one or more interactions may include data to  
2 cause the user interface module means to render a multiple choice question by providing:  
3            a question string comprising a question presented to the user;  
4            a choice array comprising a plurality of user selectable choices to present as responses  
5 to the presented question, wherein the choices in the choice array are presented on the output  
6 device with a selection mechanism to enable selection of at least one of the choices; and

7        a selection array indicating which user selectable choices were selected through the  
8    selection mechanism, wherein the selection array comprises the received user input in response  
9    to the presented question.

1            33.      The system of claim 32, wherein the interaction including data to render a  
2    multiple choice question further includes:  
3                an allowable selection variable indicating a maximum number of user selectable choices  
4    that may be indicated as selected in the selection array.

1            34.      The system of claim 28, wherein the user interface module means comprises a  
2    Controller and View components and the application program means comprises a Model  
3    conforming to the Model View Controller architecture.

1            35.      The system of claim 28, wherein multiple user interface module means are  
2    capable of generating output data from the interaction object, wherein each user interface  
3    module means generates the output data to render in a different format.

1            36.      The system of claim 35, wherein each user interface module generates the  
2    output data from the interaction object to render on a different type of output device.

1            37.      An article of manufacture including code for generating a user interface, wherein  
2    the code includes an application program that processes data and generates application output  
3    and a user interface module that processes the application output to generate output data to  
4    render on an output device by:  
5                generating output data to render on the output device in response to processing  
6    statements in the user interface module;

7 reaching a processing point where the user interface module does not include  
8 statements to generate output data;  
9 receiving an interaction object from the application program specifying data after  
10 reaching the processing point; and  
11 generating output data to render on the output device from the interaction object.

1 38. The article of manufacture of claim 37, wherein the interaction object further  
2 includes attribute information indicating characteristics of the data to output, wherein the output  
3 data is rendered in a format corresponding to the characteristics indicated in the attribute  
4 information.

1 39. The article of manufacture of claim 37, wherein the user interface module  
2 comprises a Controller and View and the application program comprises a Model conforming  
3 to the Model View Controller architecture.

1 40. The article of manufacture of claim 39, wherein the Controller includes the  
2 statements that are processed to generate output data, and wherein the Controller further  
3 performs:  
4 requesting ,the interaction object from the Model upon reaching the processing point;  
5 and  
6 transferring the received interaction object to the View, wherein the View generates the  
7 output data to render from the interaction object.

1 41. The article of manufacture of claim 40, wherein the output data generated by  
2 the model includes questions, further comprising:  
3 receiving, with the View, user input in response to the presented questions;

4 adding, with the View, the received user input to the interaction object including the  
5 output data generated by the View; and  
6 returning the interaction object including the received user input to the Model to  
7 process.

1 42. The article of manufacture of claim 41, wherein returning the interaction object  
2 including the received user input to the Model further comprises:

3 transmitting, with the View, the interaction object including the answers to the  
4 Controller; and  
5 transferring, with the Controller, the Interaction Object including the received user input  
6 to the Model.

1 43. The article of manufacture of claim 37, wherein multiple user interface modules  
2 are capable of generating output data from the interaction object, wherein each user interface  
3 module generates the output data to render in a different format.

1 44. The article of manufacture of claim 37, wherein each user interface module  
2 generates the output data to render on a different type of output device.

1 45. The article of manufacture of claim 37, further comprising:  
2 continuing to generate, with the user interface module, output data in response to  
3 processing statements in the user interface module after the output data generated from the  
4 interaction object is rendered on the output device.

1 46. An article of manufacture including code for generating a user interface, wherein  
2 the code includes an application program that processes data and generates application output

3 and a user interface module that processes the application output to generate output data to  
4 render on an output device by:

5 generating output data to render on the output device in response to processing  
6 statements in the user interface module;

7 receiving an interaction object from the application program specifying data to generate  
8 as output data;

9 generating output data to render on the output device from the interaction object from  
10 the data specified in the interaction object;

11 receiving user input in response to the output data rendered on the output device from  
12 the interaction object;

13 adding the received user input into the interaction object; and

14 returning the interaction object including the received user input to the application  
15 program.

1 47. The article of manufacture of claim 46, wherein the interaction object further  
2 specifies attribute information, wherein the output data is rendered on the output device in a  
3 format that corresponds to the specified attribute information.

1 48. The article of manufacture of claim 46, wherein the interaction object comprises  
2 a plurality of interactions, wherein each interaction includes data to cause the user interface  
3 module to render a message or question on the output device.

1 49. The article of manufacture of claim 48, wherein each interaction is capable of  
2 providing information to cause the user interface module to generate a question that is a  
3 member of a set of questions comprising:  
4 a true false question;

5           an essay question; and  
6           a multiple choice question.

1           50.       The article of manufacture of claim 48, wherein one or more interactions may

2        include data to cause the user interface module to render a multiple choice question by  
3        providing:

4            a question string comprising a question presented to the user;  
5            a choice array comprising a plurality of user selectable choices to present as responses  
6        to the presented question, wherein the choices in the choice array are presented on the output  
7        device with a selection mechanism to enable selection of at least one of the choices; and  
8            a selection array indicating which user selectable choices were selected through the  
9        selection mechanism, wherein the selection array comprises the received user input in response  
10      to the presented question.

1           51.       The article of manufacture of claim 46, wherein the interaction including data to  
2        cause the user interface module to render a multiple choice question further includes:  
3            an allowable selection variable indicating a maximum number of user selectable choices  
4        that may be indicated as selected in the selection array.

1           52.       The article of manufacture of claim 46, wherein the user interface module  
2        comprises a Controller and View components and the application program comprises a Model  
3        conforming to the Model View Controller architecture.

1           53.       The article of manufacture of claim 46, wherein multiple user interface modules  
2        are capable of generating output data from the interaction object, wherein each user interface  
3        module generates the output data to render in a different format.

1        54.     The article of manufacture of claim 53, wherein each user interface module  
2     generates the output data from the interaction object to render on a different type of output  
3     device.